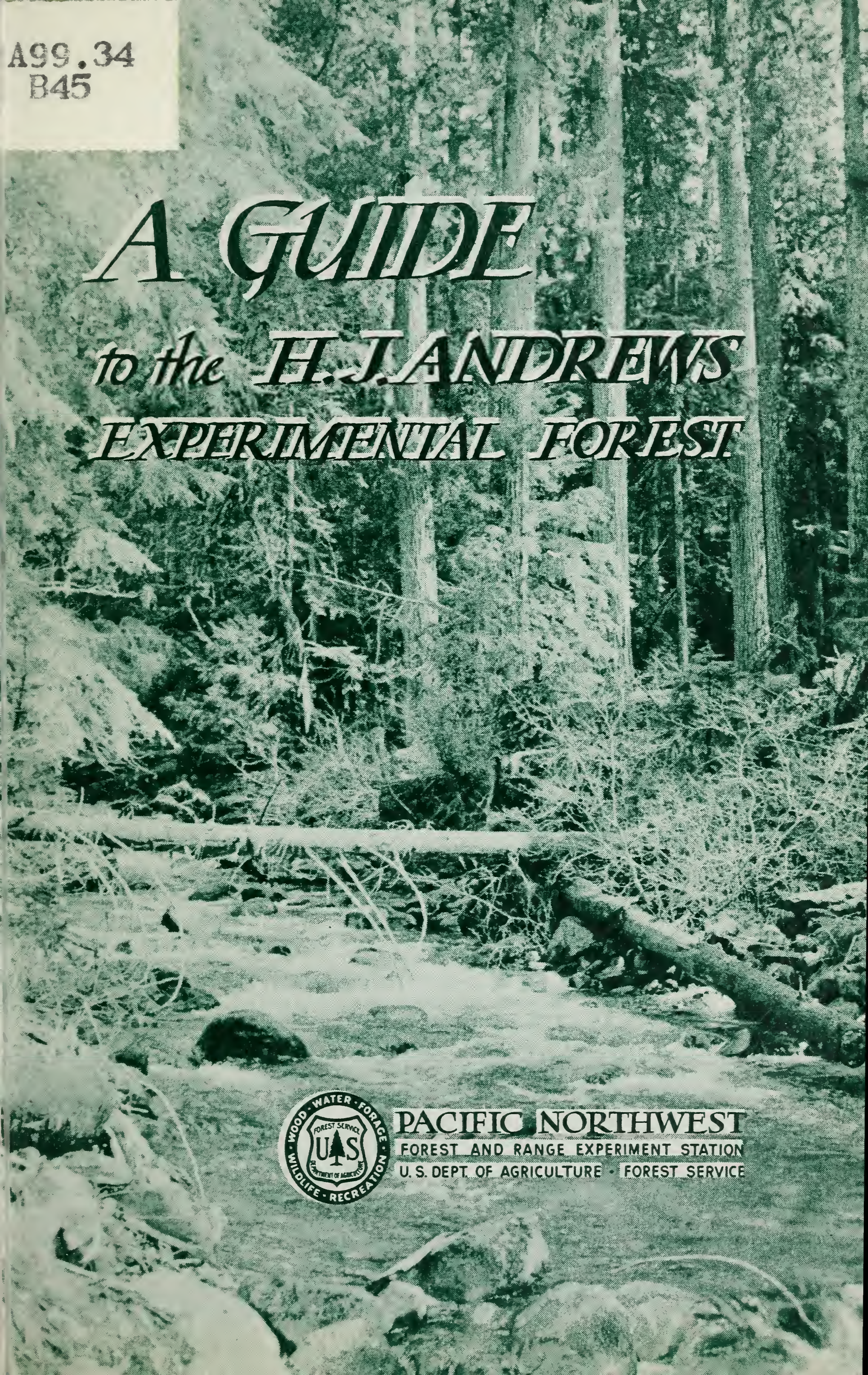
A GUIDE to the H. J. ANDREWS EXPERIMENTAL FOREST



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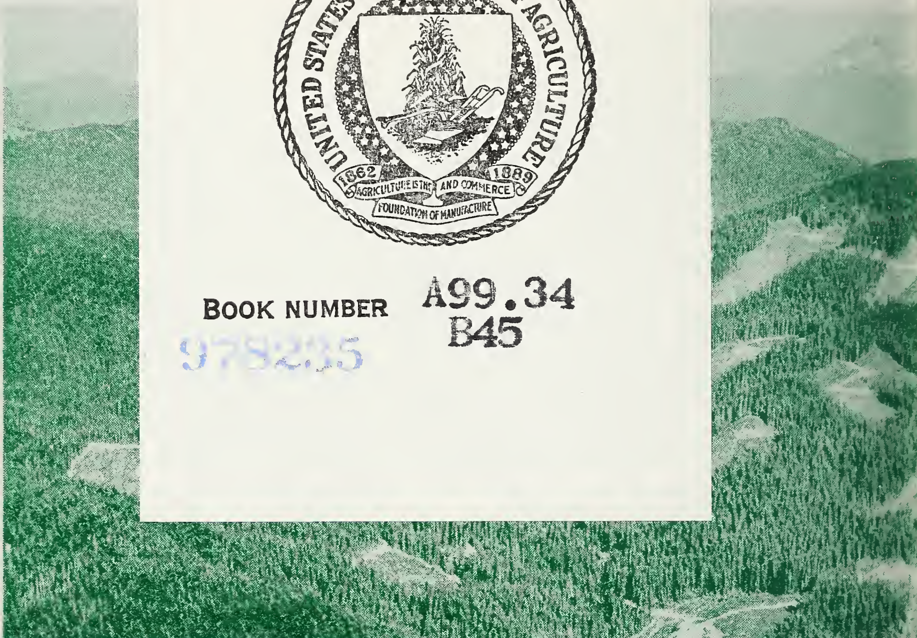

General characteristics of the road pattern and layout of clearcut units are shown in this aerial view of the H. J. Andrews Experimental Forest. Along the skyline are the Three Sisters, prominent peaks of the Cascade Range.

A guide to the

H. J. ANDREWS EXPERIMENTAL FOREST

by

Carl M. Berntsen and Jack Rothacher

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PACIFIC NORTHWEST
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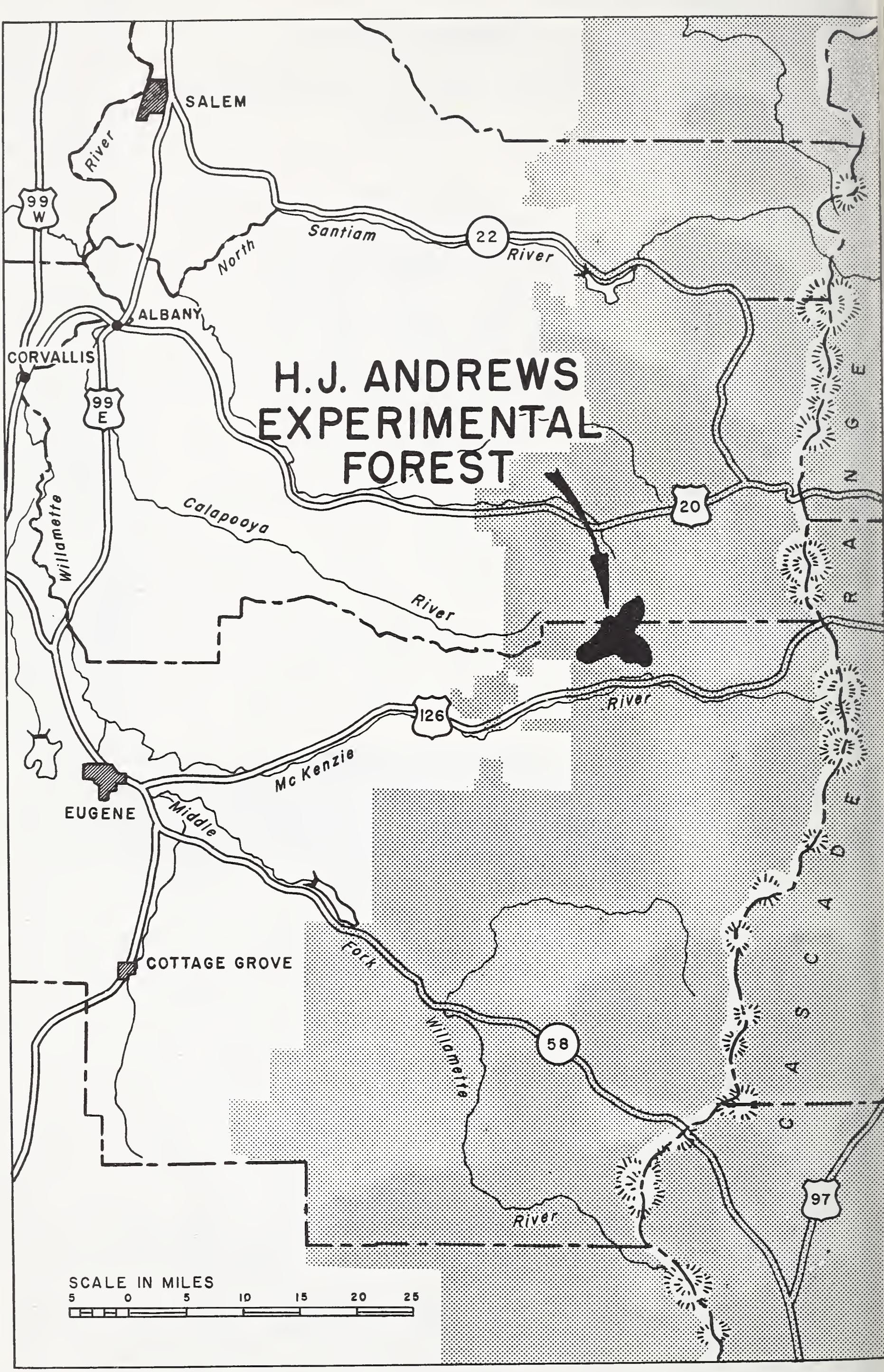

H.J. ANDREWS
EXPERIMENTAL
FOREST
SALEM
ALBANY
CORVALLIS
EUGENE
COTTAGE GROVE
River
North
Santiam
River
Calapooya
River
Willamette
Mc Kenzie
River
Middle
Fork
Willamette
River
99 W
99 E
22
20
126
58
97
CASCADE RANGE
SCALE IN MILES
5 0 5 10 15 20 25

INTRODUCTION

The H. J. Andrews Experimental Forest, one of several experimental forests in the Pacific Northwest, was established July 28, 1948, by the chief of the U.S. Forest Service under authority granted him by the Secretary of Agriculture. The entire 15,000-acre drainage of Lookout Creek, in the Willamette National Forest, was set aside for development of better methods of managing forests for sustained production of timber, water, fish, and wildlife.

The experimental forest is administered jointly by the administrative and research branches of the Forest Service. Timber sales, fire protection, and construction and maintenance of roads are responsibilities of the Willamette National Forest. Research work is done by the Pacific Northwest Forest and Range Experiment Station through its research center office at Corvallis, Oreg. This office is maintained in cooperation with the School of Forestry, Oregon State College.

Headquarters of the experimental forest are at the Blue River Ranger Station, Blue River, Oreg., where an office and a residence are maintained for the officer in charge. The forest itself is about 40 miles east of Springfield, Oreg., and 5 airline miles north of the McKenzie Highway (U.S. 126).

PURPOSE

The H. J. Andrews Experimental Forest was established to study forest and watershed management problems associated with the conversion of old-growth Douglas-fir and upper-slope (mountain hemlock–noble fir) forests of the Cascade Range to productive young-growth forests. Studies conducted on the forest seek management methods that will provide the most efficient utilization of old-growth forests without detriment to other forest values, and that will lead to establishment of young growth with a minimum of delay.

TOPOGRAPHY, CLIMATE, AND SOIL

Most of the area is relatively steep; only about one-fifth is benches or gentle slopes. Elevations within the forest vary from about 1,500 feet to more than 5,000 feet. The two highest peaks are Carpenter Mountain, on the northern boundary, and Lookout Mountain, in the southeast corner. Rock outcroppings occur frequently in steeper areas of the forest, and old lava flows have formed lines of bluffs at some elevations.

Precipitation is heavy, varying from about 89 inches per year in the lower reaches of Lookout Creek to as much as 140 inches per year along the highest ridges. Rain predominates at the lower elevations, but considerable snowpack develops on the higher slopes. Mean temperatures within the forest range from 35° F. in January to 65° in midsummer. Extreme temperatures--below 0° or above 100°--are uncommon.

The three principal soil types are all of volcanic origin. A residual clay loam, formed from andesite and basalt, is common high on the steeper slopes and on ridgetops. A residual silty clay loam--formed from agglomerates, tuff, and breccia--is characteristic of midslope and low-ridge positions. This soil is very unstable and easily disturbed by road construction. The third soil, a clay loam formed from colluvial materials, occupies gentle slopes and benches. All three soil types support forest vegetation and are strongly acid.

FOREST TYPES

The predominant forest type, Douglas-fir, occurs in a complete range of size classes--from seedlings to large, overmature timber. Quality of old-growth Douglas-fir is good, and stands contain a fair percentage of peeler-grade logs. The other important type, true fir, includes all the high-elevation species found on the forest, principally silver fir, noble fir, and white pine. This type is of only average quality, but it contains a considerable volume of high-quality noble fir.

A complete list of vegetation types and timber volumes (1948) is provided in the appendix.

RESEARCH PROGRAM

When the H. J. Andrews Experimental Forest was established, access was limited to foot and horseback trails on the ridgetops around the Lookout Creek drainage. Initial activity centered about the development of an extensive road plan and a timber harvesting program. This program, with modifications, is still being carried out--to provide access to a generous variety of study areas, and to study the problems involved in converting virgin forest into more useful, managed forest. Individual studies have been added as suitable areas became available.

The selection of timber to be harvested during the first cutting cycle was originally based upon the desire for rapid road development. Later, however, selections were determined by stand condition and the need for protection of reserve timber from fire and wind (Ruth and Silen, 1950).[1/]

Road Development

Careful planning to reduce the total length of road and the costs of construction and hauling will materially reduce total logging cost. An efficient road system will have proper spacing of road levels and appropriate standards of alignment and grade. Also, because separate stands of timber are cut, leaving intervening stands of reserve timber (staggered-setting system), the road system must serve both the units cut now and those that will be harvested later. These economic and engineering needs--along with applicable silvicultural, protection, and watershed needs--were considered in preparing a road development plan for the forest. A systematic road pattern, based upon parallel roads and a minimum of steep connecting roads, proved superior to other patterns considered. This pattern resulted in a road density of 4.97 miles per square mile.

The original development plan was modified frequently as on-the-ground surveys revealed unforeseen obstacles to road construction or acceptable logging practices. But by 1953, 72 miles of road had been located and about 580 log gathering points

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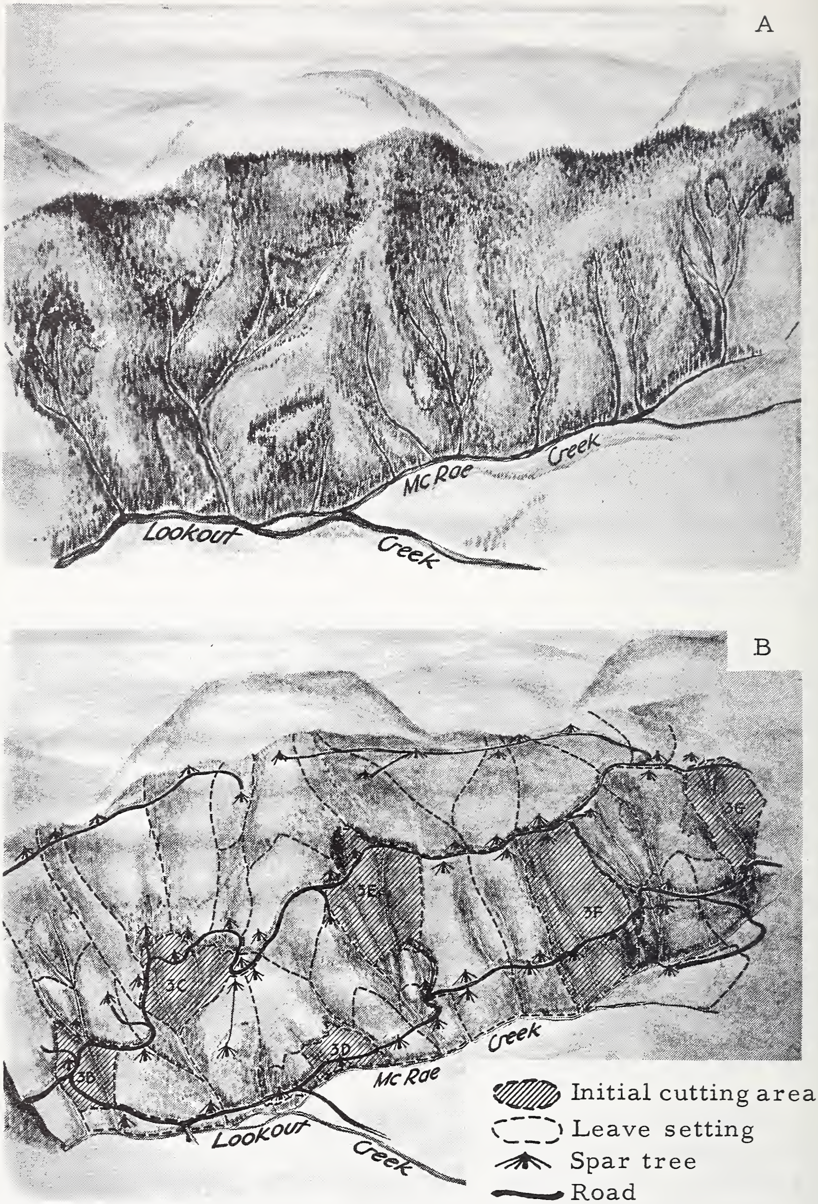
1/ Names and dates in parentheses refer to the list of publications, page 18.



The forestry-logging plan put into practice on the H. J. Andrews Experimental Forest considers economic, silvicultural, engineering, fire protection, and watershed needs of the drainage. A, The virgin stand on a segment of the experimental forest. B, The same segment, showing the initial cut and the complete forestry plan.

(landings) had been marked. By 1956, 30 miles of all-weather, rock-surfaced road had been built (Silen and Gratkowski, 1953; Silen, 1955).

Time-Cost Studies

Cost records are obtained by the research staff from each logging operator on the experimental forest. Normally, logging methods are conventional and the records consist only of monthly itemized statements of the amounts spent on logging and road construction. These records are of value primarily for the basic information they contain, but they are also used in appraising timber for future sale.

The testing of new techniques or equipment requires special records for study. An example is the timing of log movement from the forest to the nearest landing (yarding). A detailed record of the intervals between log arrivals at the landing can be used with size of logs, pitch of slope, and other information to compare the costs of various yarding techniques.

Salvage Logging Studies (B)[2]

Some of the reserve timber left by staggered-setting cutting in the Douglas-fir subregion must be managed for as long as 90 years before harvesting. Within these stands of reserve timber (leave settings) thousands of board feet of usable wood are subject to decay unless they can be salvaged. In addition, dead or dying trees harbor insects and disease and are more likely to ignite if struck by lightning.

In 1954, tests were begun on the experimental forest to determine the capability of a mobile yarder-loader in staggered-setting salvage work. The tests were conducted under actual operating conditions, with the yarder-loader working from small landings along main truck roads and intermediate low-standard roads.

Detailed study of this operation revealed that salvage in residual stands can be accomplished at reasonable cost with

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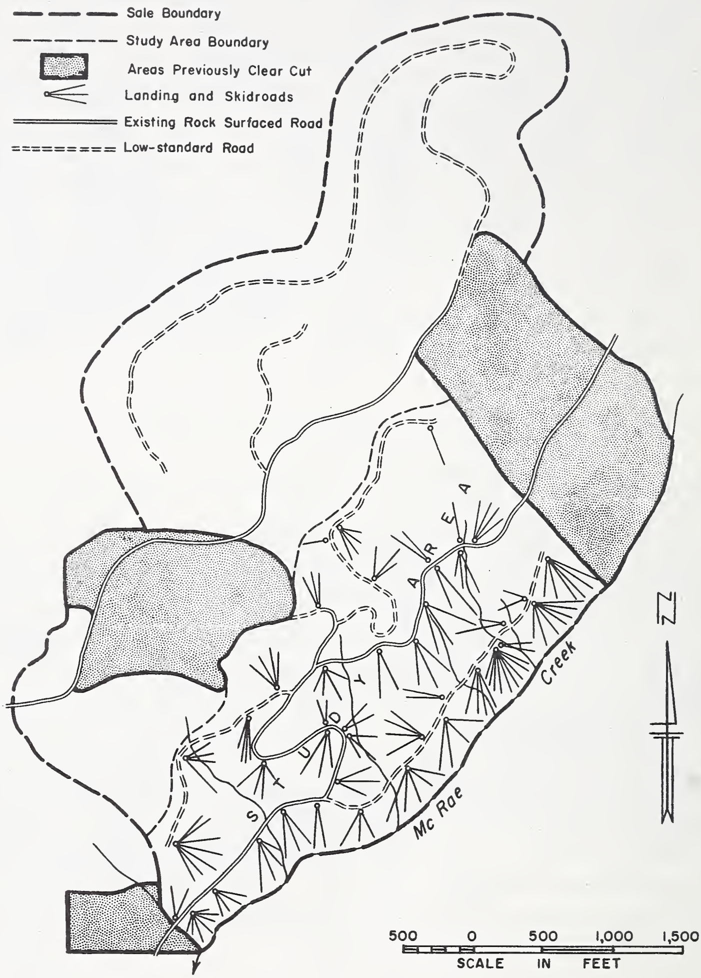
[2] Capital letters in parentheses refer to location of studies on centerspread map.

relatively minor damage to healthy trees. An average timber vo[illegible] ume of 14,700 board feet per acre was recovered in the tests, in[illegible] cluding some Douglas-fir that was defective but could be peeled f[illegible] veneer (Carow and Ruth, 1957; Carow, 1959).



Road pattern used for salvage in old-growth leave settings. Roads located between main truck road levels were low cost, designed for dry-weather use. This system permitted complete coverage of leave units.

The mobile yarder-loader machine used for salvage logging in old-growth residual stands.

Regeneration Studies (C, D, E, F, G, H)

The staggered-setting system of timber harvesting is designed to provide a maximum seed source for clear-cut areas. Although the system contributes generously toward natural regeneration, supplemental planting is frequently necessary.

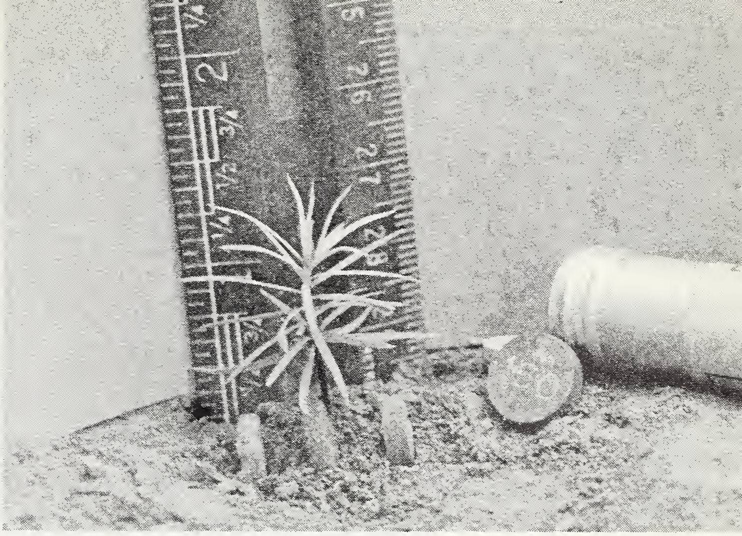
Surveys of natural regeneration are being made on the forest in an attempt to determine the factors affecting seedling survival. Mineral soil, moisture, and protective shade have all been shown to be important, but the most significant observation to date has been that 90 percent of all of the surviving seedlings that were surveyed had some permanent shade on the lower one-fourth inch of their stems.

Two-year-old nursery seedlings have been planted extensively to supplement natural regeneration, but some areas remain difficult to restock. Foremost of these areas are the steep south slopes, where combinations of heat, drought, and surface movement of the soil cause severe seedling mortality.

One field trial on the forest showed that 3-year-old seedlings survived better than 2-year-old seedlings under similar conditions. The better survival of the older planting stock was attributed primarily to a greater resistance to covering by surface debris (Berntsen, 1958).

Strip cuttings in the foreground are part of a study of regeneration in small clearcuts close to an adequate seed source and where the residual stand provides some shade for freshly germinated seedlings.

Artificial seedbed study was made to explore ways of overcoming seedling losses due to hot seedbed conditions. Seedbeds shown above were white silica sand of different size particles. Other seedbed materials included basalt gravel, mineral soil, needle litter, vermiculite, and charred surface material.



Using pellets calibrated at melting points of 125°, 138°, and 150° F., good estimates were obtained of the percentage of clearcut area that became too hot for survival of freshly germinated seedlings.

The influence of slash burning on soils and regeneration has been the subject of several studies. These have shown that broadcast slash burning does not alter soil properties significantly nor retard the growth of new tree seedlings.[3/]

Tests of non-native species are presently limited to one small plantation of corkbark fir (Abies lasiocarpa var. arizonica). This species, a native of Arizona, was successfully established on the forest in 1952 at an elevation of 2,900 feet. After 2 years, 72 percent of the stock planted had survived, and vigor was good.

Protection Studies (I, J)

Damaging agents--such as fire, wind, disease, and insects--constitute a substantial drain on the timber resource. Losses from wind are especially prevalent when openings created by clear cutting expose perimeter trees to the full force of storm winds. The major losses from blowdown result from breakage of perimeter trees,

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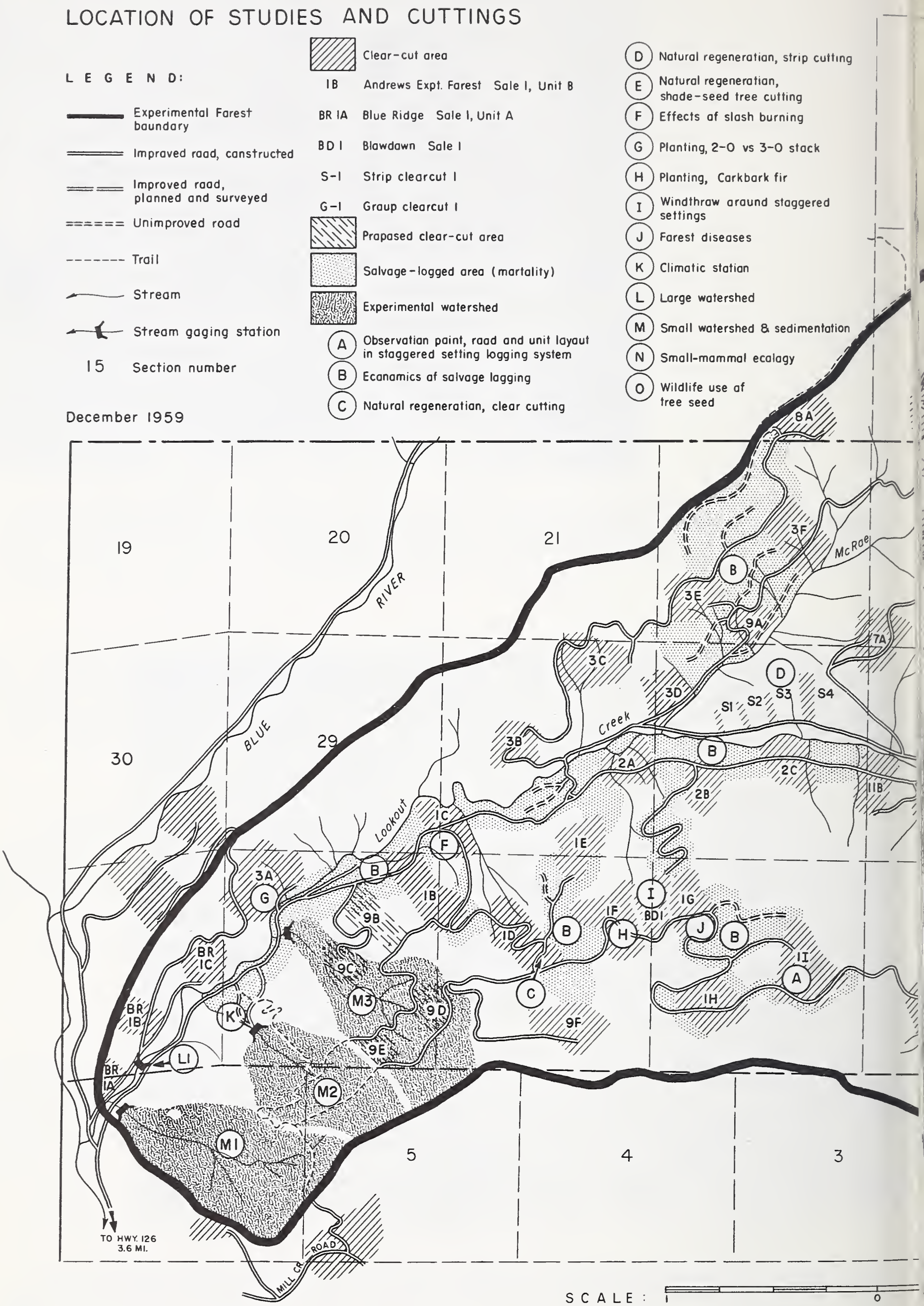
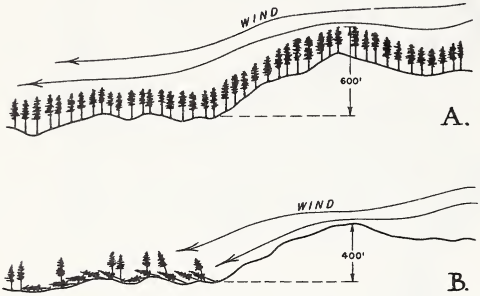
3/ Silen, 1952; Tarrant, 1954; Tarrant, 1956a; Tarrant, 1956b; Tarrant and Wright, 1955.



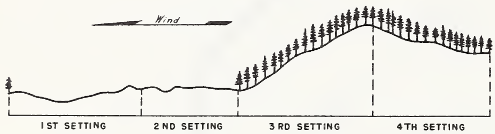
H. J. ANDREWS EXPERIMENTAL FOREST

WILLAMETTE NATIONAL FOREST, OREGON

damage to surrounding trees, and decay of fallen trees. In addition, dead trees create a hazard through potential fire or buildup of destructive insects.



Windflow over a ridge before cutting (A) and after cutting (B).



Cutting pattern suggested for wind-exposed ridgetops.

A study of blowdown in the staggered-setting system showed that losses might be minimized by cutting settings successively in the direction from which storm winds prevail, leaving a windfirm stand on a windward slope for the final cut. The study also showed that wind damage could be reduced by (1) removing defective perimeter trees, (2) placing cutting boundaries outside marshes and other poorly drained areas, and (3) making use of topographic features that provide natural windfirmness (Gratkowski, 1956).

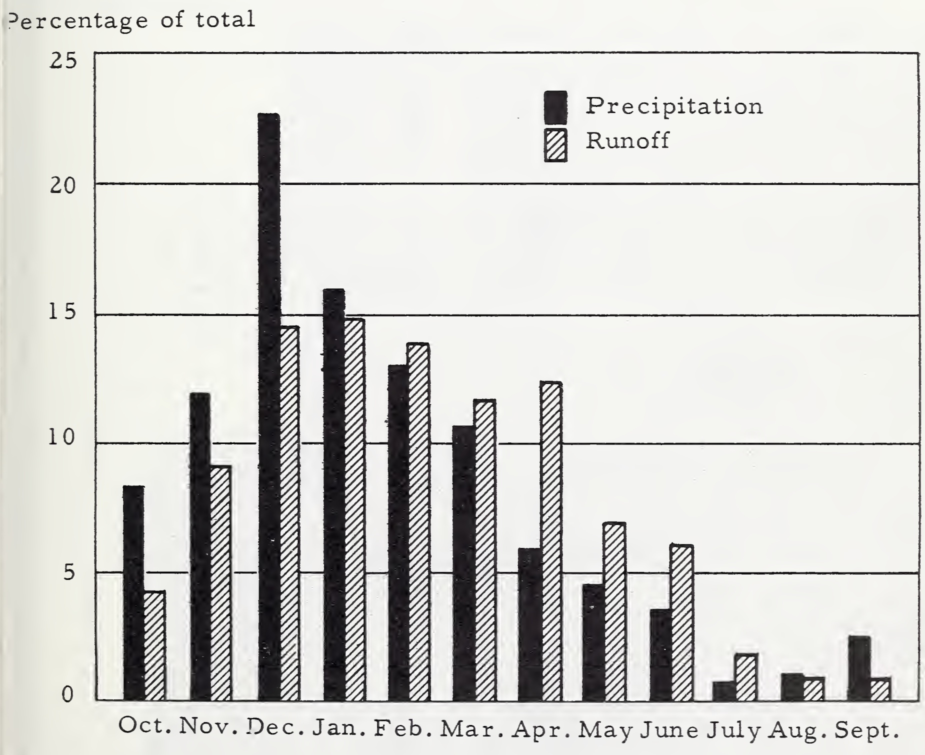
A long-term study of the threat of root and trunk rots to successful conversion of old-growth forest was begun in 1951, with the identification of Poria weirii and other diseases in an infected clearcut. Examinations will be made every few years to determine whether these rots carry over to the next generation of trees.

Watershed Studies (K, L, M)

Precipitation records have been maintained along lower Lookout Creek since 1951. In the 7 years following the installation of the recording rain-snow gage, precipitation has averaged 88.8 inches per year, with a range from 55.5 to 114.5 inches.

Approximately 82 percent of the annual rainfall on the experimental forest occurs from October through March, filling the watershed's natural storage to capacity. This stored water, together with the snowpack in the upper elevations of the drainage, maintains streamflow during the summer months.

Waterflow from Lookout Creek drainage (24.1 square miles) is automatically recorded by a stream gage located near the point where the stream leaves the experimental forest. For



Average annual distribution of precipitation and runoff from the Lookout Creek drainage.

comparison, similar records are made on the adjoining drainage of upper Blue River (11.5 square miles), where no logging or roa construction has taken place.

In the first 7 years of logging on the Lookout Creek drainage, 30 miles of roads were built and approximately 100 million board feet of timber removed. About 8.2 percent of the entire drainage was clear cut. This rate of logging is somewhat greater than the normal allowable cut for an area of this size, but has resulted in no appreciable change in the streamflow as compared wit with the upper Blue River drainage. However, there has been an increase in the turbidity of Lookout Creek during periods of high runoff.

On three small drainages (149 to 250 acres) that are to be used for detailed watershed research, the normal silt load in streams is being measured by analyzing water samples taken peri odically from the streams. Data compiled from these samples

Following a streamflow calibration period, these three matched drainages on the experimental forest will be used in a study of erosion and sedimentation from road building and logging. Treatment will consist of clear cutting with a skyline crane (No. 1) and clear cutting by the staggered-setting system (No. 3). Drainage No. 2 will be left untreated as a control. Another purpose of the study is to measure how streamflow behavior is affected by removal of timber.

thus far indicate that the normal silt load, under natural conditions, rarely exceeds 3 parts of suspended sediment per million parts of water (3 p.p.m.). Under extreme conditions of streamflow caused by heavy rains, the silt load may be as high as 200 p.p.m. for a short time, but it quickly returns to normal after reaching a peak. In 1957, immediately following several landslides, the silt load of Lookout Creek reached 800 p.p.m.

In late 1952, a trapezoidal flume was installed on each of the three small drainages under investigation. Since installation of the flumes, continuous records have been kept to provide data about streamflow under natural conditions. Preliminary analysis of these data shows that peak flows of as much as 140 cubic feet per second per square mile have been recorded in December and January. In September, streamflow approaches 0.1 cubic feet per second per square mile.

One of the trapezoidal flumes installed on the three matched drainages.

In the experimental phase of these studies, watershed No. 1 will be logged by a skyline system that requires no roads across the drainage, watershed No. 2 will remain undisturbed for comparison, and watershed No. 3 will be logged in the conventional manner, with normal road construction.

Loose soil from cut road banks accumulates at the base of the slope, filling the ditch. Heavy winter rains move this material down the ditch, carrying it into natural stream channels.

Small plots on the three watersheds will be used to determine the key sources of erosion, and emphasis of the study will be on methods of reducing to a minimum the soil movement from these sources. Throughout the study, measurements will be made of streamflow, suspended silt, and stream bedload.

Debris basins at the lower ends of the small study drainages are used for measuring stream bedloads. During the 3-year period 1956-59, sediment accumulation in the basins averaged 1.5 cubic feet per acre of drainage.

Preliminary data from companion studies indicate that old-growth Douglas-fir forests prevent a sizable proportion of rainfall from reaching the ground. Apparently, the forest intercepts about a quarter of the gross rainfall during summer and early fall, and about 15 percent during the wetter part of the year.

Cooperative Studies (N, O)

Studies of the effects of timber harvesting on the fish and wildlife of the forest are being conducted by the U. S. Fish and Wildlife Service and the Oregon Cooperative Wildlife Research Unit.

The Fish and Wildlife Service is studying small-animal populations before, during, and after logging, and the relation of these animals to forest seed fall. Home ranges and reproductive habits of some of these small mammals are also under investigation. Apparently, chipmunks and red-backed mice do not like logged or burned units, and quickly move into green timber. But, on the other hand, deer mice continue to live in logged units and show signs of population increase (Gashwiler, 1959).

The Oregon Cooperative Wildlife Research Unit has undertaken studies of fish and large game animals. The population of large game animals, particularly black-tailed deer, has shown a noticeable increase since logging began. Use of the area by deer is not year round, however, as they move to lower elevations during the winter. Studies of native fish indicate that home ranges are usually limited and fish may spend their entire lives in a very small orbit. Fish censuses indicated that sedimentation due to logging temporarily reduced the trout population in small streams, but the population in the main stream, Lookout Creek, remained relatively stable (Silen, 1955).

Seining to determine fish population in a hole on Lookout Creek.

IN CONCLUSION

The research conducted on the H. J. Andrews Experimental Forest is dedicated to forest and watershed management problems important to old-growth Douglas-fir and upper-slope forests and the conversion of these forests to productive young stands. We hope our work on these problems is contributing to better management for "the greatest good of the greatest number in the long run." Please feel free to request additional information on studies of interest to you.

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1954. Tarrant Robert F. Effect of slash burning on soil pH. Pac. NW. Forest and Range Expt. Sta. Res. Note 102, 5 pp.

1955. Silen, Roy R. More efficient road patterns for a Douglas fir drainage. The Timberman 56(6): 82, 85-86, 88, illus.

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1956a. Tarrant, Robert F. Effect of slash burning on some physical soil properties. Forest Sci. 2: 18-22, illus.

1956b. Tarrant, Robert F. Effects of slash burning on some soils of the Douglas-fir region. Soil Sci. Soc. Amer. Proc. 20: 408-411, illus.

1957. Anonymous. Can there be orderly harvest of old growth? The Timberman 58(3): 48-52, illus.

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1959. Gashwiler, Jay S. Small mammal study in west-central Oregon. Jour. Mammal. 40: 128-139, illus.

1959. Rothacher, Jack. How much debris down the drainage? The Timberman 60(6): 75-76, illus.

APPENDIX

Vegetation Types and Timber Volumes (1948)

Principal forest type	Average volume per acre (M b.m.)	Total volume (M b.m.)
Large old-growth Douglas-fir	80	240,000
Small old-growth Douglas-fir	70	306,250
Second-growth Douglas-fir	50	121,250
True fir	50	134,250
Total		801,750

Plant Species

Common and scientific names of plants present on the experimental forest follow. Those included in "Check List of Native and Naturalized Trees of the United States" (U.S. Dept. Agr. Handb. 41, 1953) are named accordingly. Others are named according to "Standardized Plant Names" (Kelsey and Dayton, Ed. 2, 1942), except that two species of herbs not listed by that authority are named according to "A Manual of the Higher Plants of Oregon" (Peck, 1941). These two species are designated by an asterisk.

Coniferous tree species present in principal forest types are as follows:

Douglas-fir	Pseudotsuga menziesii
Western hemlock	Tsuga heterophylla
Western redcedar	Thuja plicata
Incense-cedar	Libocedrus decurrens
Noble fir	Abies procera
Pacific silver fir	Abies amabilis
Grand fir	Abies grandis
Mountain hemlock	Tsuga mertensiana
Western white pine	Pinus monticola
Pacific yew	Taxus brevifolia
Sugar pine	Pinus lambertiana
Subalpine fir	Abies lasiocarpa

Principal associated species present in principal forest types are:

Woody plants

Red whortleberry (huckleberry)	Vaccinium parvifolium
Cascades mahonia	Mahonia nervosa
Salal	Gaultheria shallon
Pacific rhododendron	Rhododendron macrophyllum
American devilsclub	Oplopanax horridus

Herbaceous plants

American twinflower	Linnaea borealis var. americana
Oregon oxalis	Oxalis oregana
Western swordfern	Polystichum munitum

Additional species prominent on clearcuts and in stand openings are:

Woody plants

Snowbrush ceanothus	Ceanothus velutinus
Redstem ceanothus	Ceanothus sanguineus
Blueberry elder	Sambucus glauca
Pacific dogwood	Cornus nuttallii
Golden chinkapin	Castanopsis chrysophylla
Western thimbleberry	Rubus parviflorus
Willow	Salix spp.
Red alder	Alnus rubra
Sitka alder	Alnus sinuata
California hazel	Corylus cornuta var. californica
Bigleaf maple	Acer macrophyllum
Vine maple	Acer circinatum
Grapeleaf California dewberry (trailing blackberry)	Rubus ursinus var. vitifolius

Herbaceous plants

Fireweed	Epilobium angustifolium
Modest whipplea	Whipplea modesta
Western starflower	Trientalis latifolia
Common pearleverlasting	Anaphalis margaritacea
Autumn willowweed	Epilobium paniculatum
*Small-flowered willow-herb	Epilobium minutum
*Western hawkweed	Hieracium albertinum

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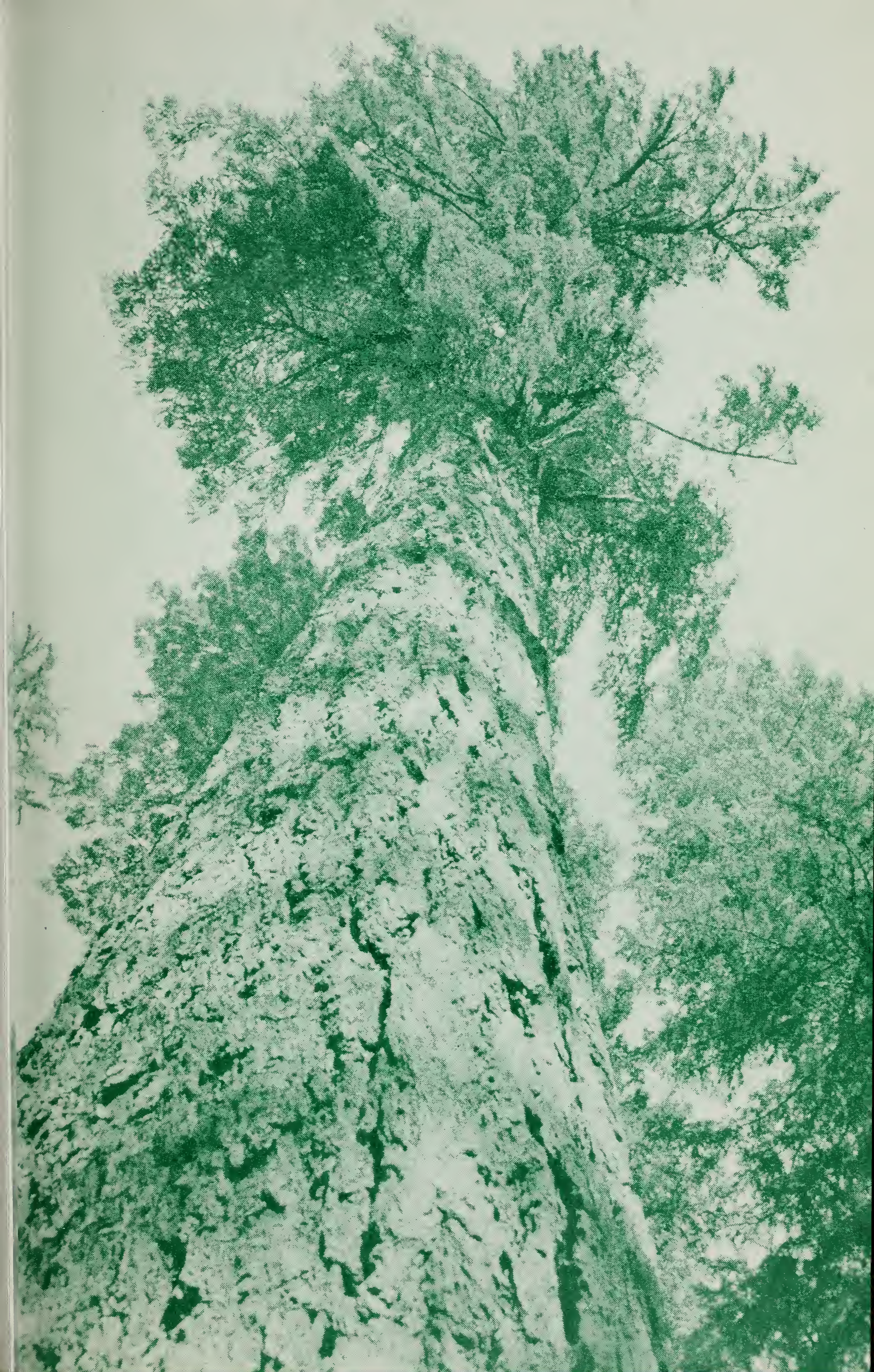

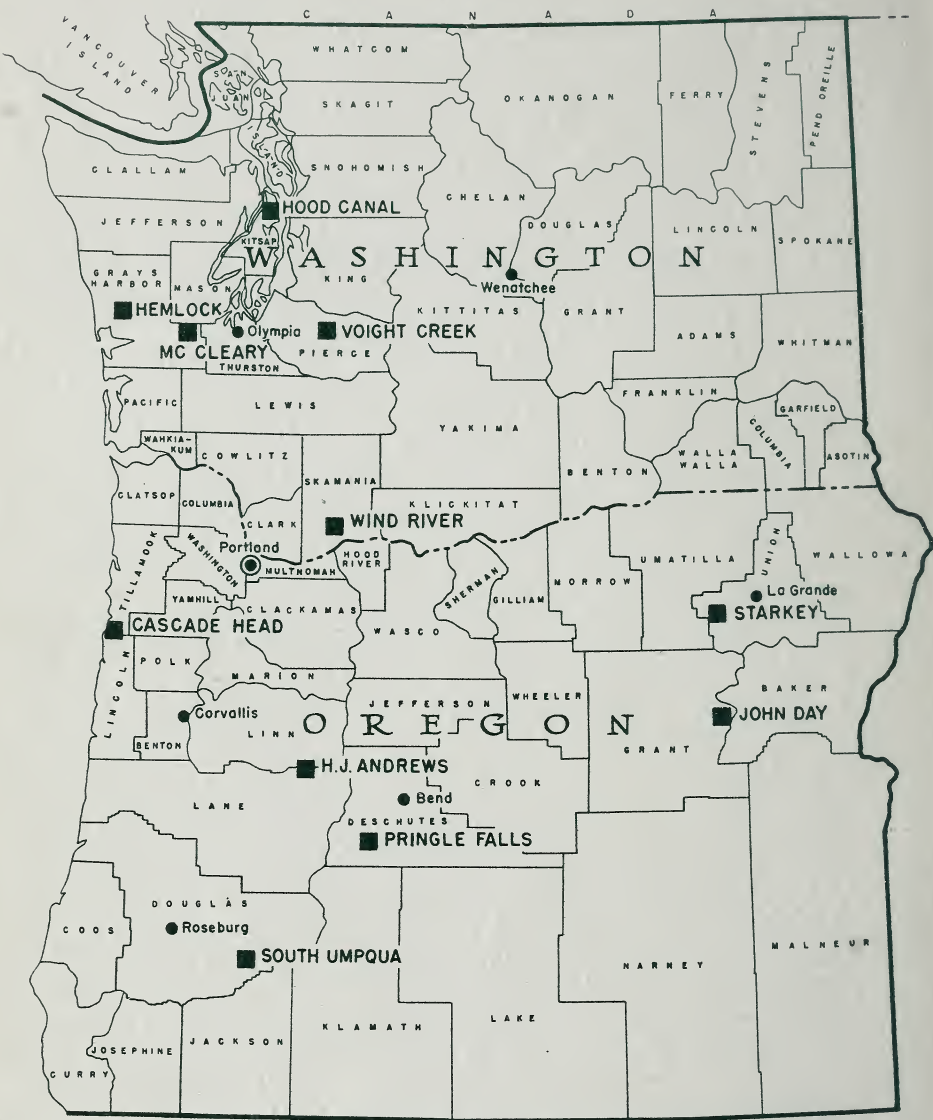

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